Closed-loop Wavefront Correction for High-Contrast Imaging: the "Peak-a-boo" Algorithm

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High contrast imaging from space must overcome photon noise of the diffracted star light and scattered light from optical components defects. The very high contrast required (up to 10^{-10} for terrestrial planets) puts severe requirements on the wavefront control system, as the achievable contrast is limited by the quality of the wavefront. The ``Peak-a-boo'' correction algorithm, presented here, is a closed loop correction method for the Lyot coronagraph and the shaped pupil coronagraph that minimizes the energy in a pre-defined region in the image where terrestrial planets would be found. The reconstruction part uses three intensity measurements in the image plane with a pinhole added to the shaped pupil for diversity. This method has been shown in simulations to converge to the nominal contrast in 2-3 iterations. In addition, the ``peak-a-boo'' has shown to be effective in broadband light conditions.